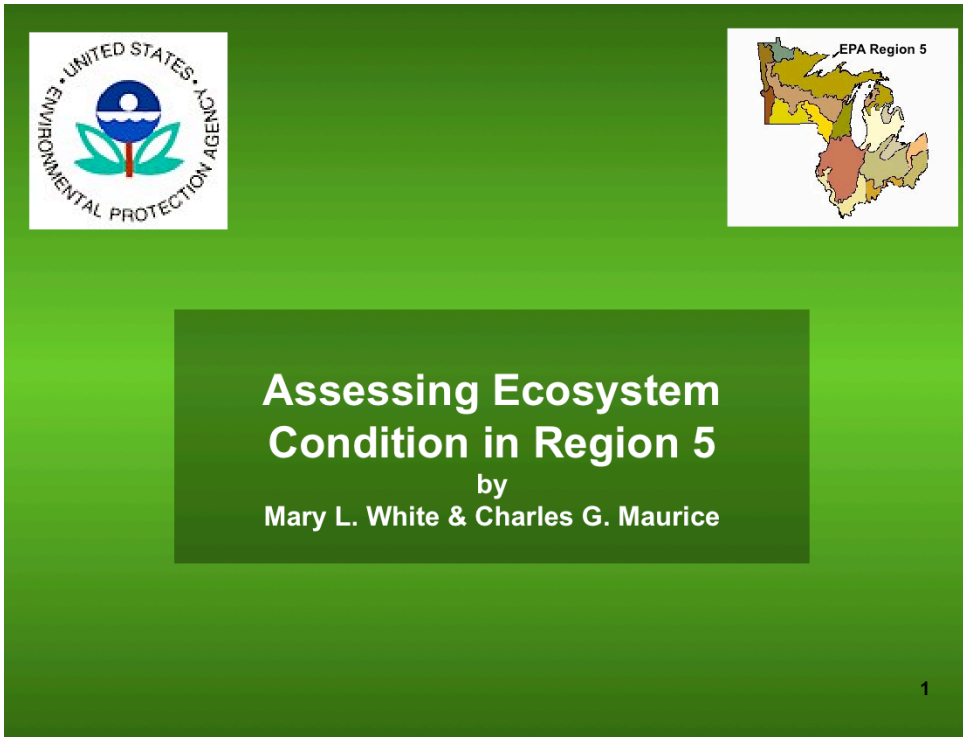

UNITED STATES • ENVIRONMENTAL PROTECTION AGENCY •
EPA Region 5
Assessing Ecosystem Condition in Region 5
by
Mary L. White & Charles G. Maurice
1

Goal 4

HEALTHY COMMUNITIES AND ECOSYSTEMS

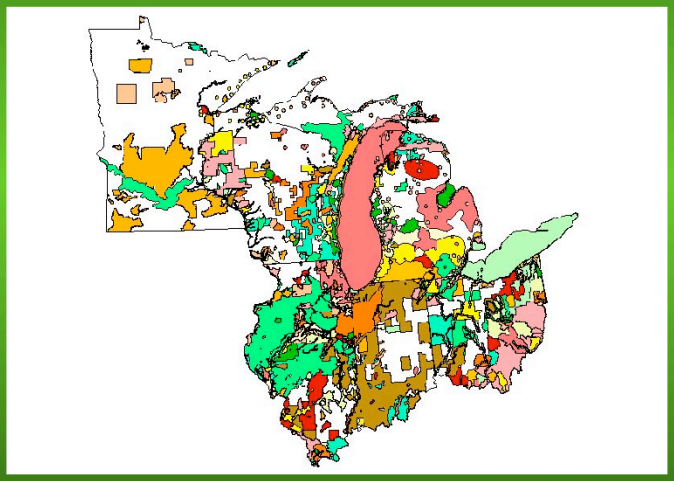
Protect, sustainor restore the health of people, communities, and ecosystems using integrated and comprehensive approaches and partnerships.

Objective 4.3 Restore and protect critical ecosystems

But how do we
Prioritize issues?
Measure success?

2

Partner Identified Ecosystems



3

Critical Ecosystem Assessment Model

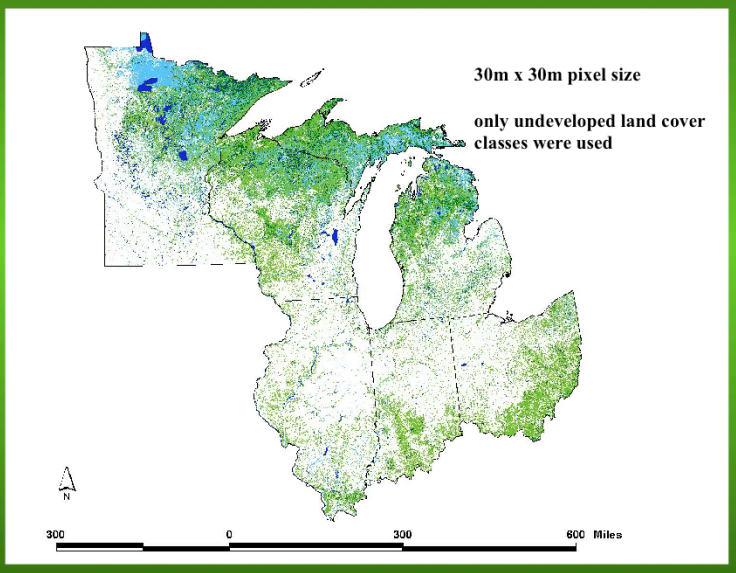
CrEAM

Three Criteria –
- Diversity
- Sustainability
- Rarity

Indicator data sets to populate these criteria
- Diversity – four data sets
- Sustainability – twelve data sets
- Rarity – four data sets

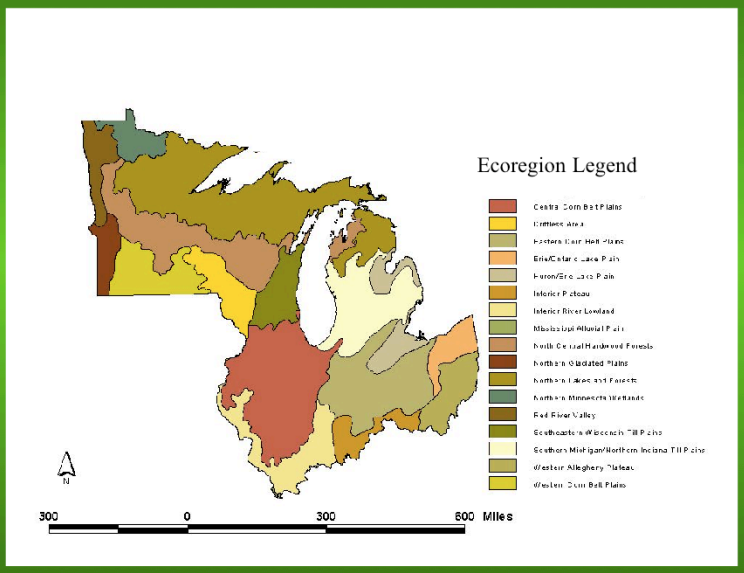
4

Base Map – National Land Cover Data Base 1992

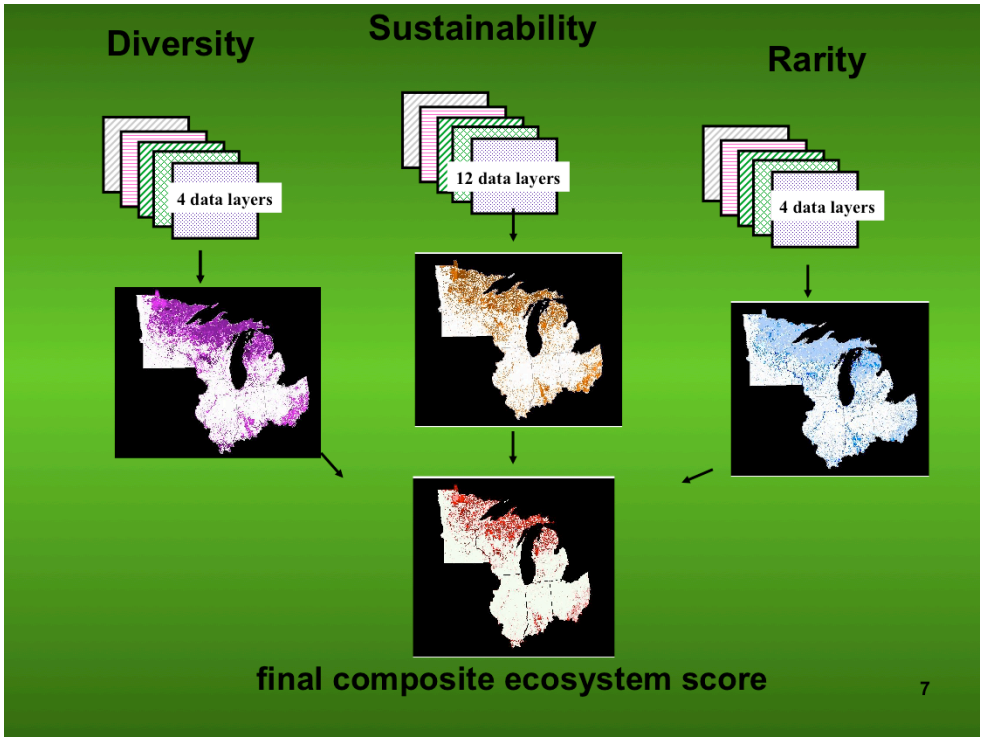


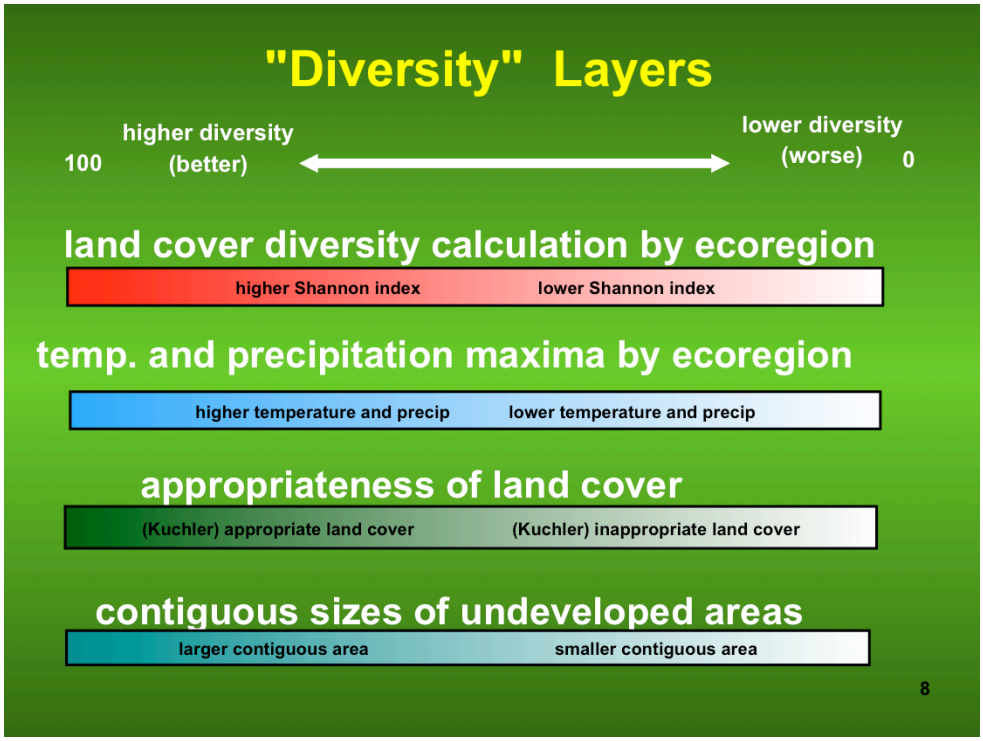
5

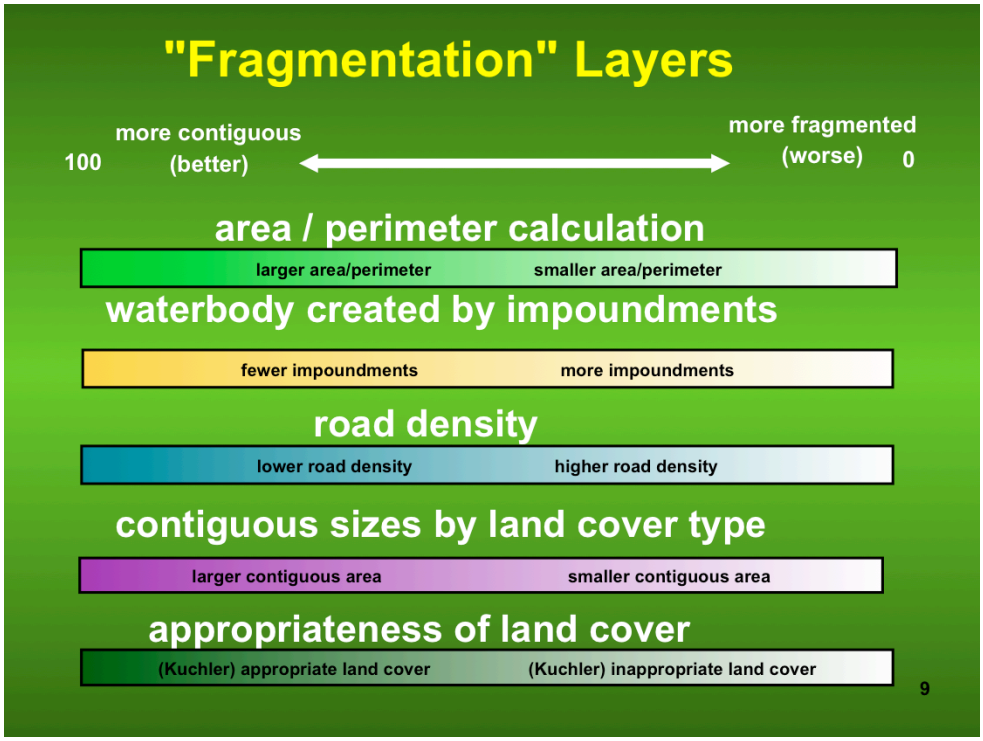
Omernik Ecoregions for Region 5

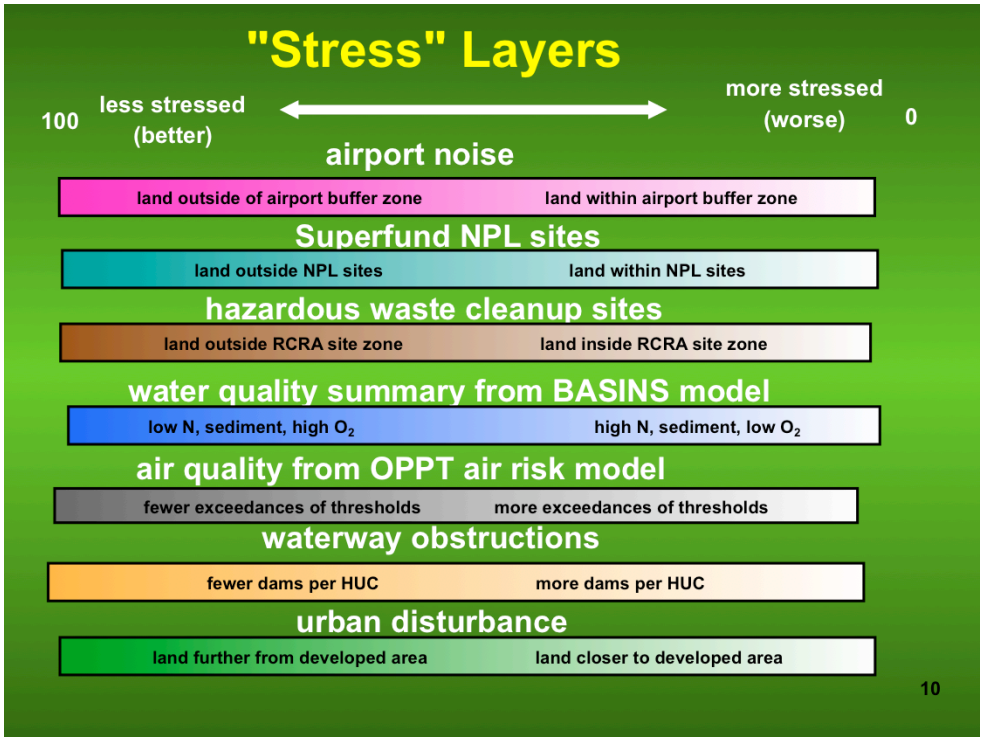


6


Diversity
Sustainability
Rarity
4 data layers
12 data layers
4 data layers
final composite ecosystem score
7


"Diversity" Layers
higher diversity
(better)
100
lower diversity
(worse)
0
land cover diversity calculation by ecoregion
higher Shannon index
lower Shannon index
temp. and precipitation maxima by ecoregion
higher temperature and precip
lower temperature and precip
appropriateness of land cover
(Kuchler) appropriate land cover
(Kuchler) inappropriate land cover
contiguous sizes of undeveloped areas
larger contiguous area
smaller contiguous area
8


"Fragmentation" Layers
more contiguous
(better)
100
more fragmented
(worse)
0
area / perimeter calculation
larger area/perimeter
smaller area/perimeter
waterbody created by impoundments
fewer impoundments
more impoundments
road density
lower road density
higher road density
contiguous sizes by land cover type
larger contiguous area
smaller contiguous area
appropriateness of land cover
(Kuchler) appropriate land cover
(Kuchler) inappropriate land cover
9


"Stress" Layers
100
less stressed (better)
more stressed (worse)
0
airport noise
land outside of airport buffer zone
land within airport buffer zone
Superfund NPL sites
land outside NPL sites
land within NPL sites
hazardous waste cleanup sites
land outside RCRA site zone
land inside RCRA site zone
water quality summary from BASINS model
low N, sediment, high O2
high N, sediment, low O2
air quality from OPPT air risk model
fewer exceedances of thresholds
more exceedances of thresholds
waterway obstructions
fewer dams per HUC
more dams per HUC
urban disturbance
land further from developed area
land closer to developed area
10

"Rarity" Layers

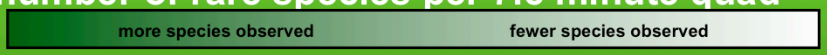
more rare species and features — fewer rare species and features

100 (better) ⟷ (worse) 0

land cover rarity by ecoregion

species rarity per 7.5 minute quad

number of rare species per 7.5 minute quad



number of rare taxa per 7.5 minute quad

* Raw rare species data used to generate these 3 layers were provided by the Natural Heritage Programs of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin in cooperation with The Nature Conservancy. These data are confidential business information and cannot be provided or reproduced without written consent of the corresponding Natural Heritage Program.

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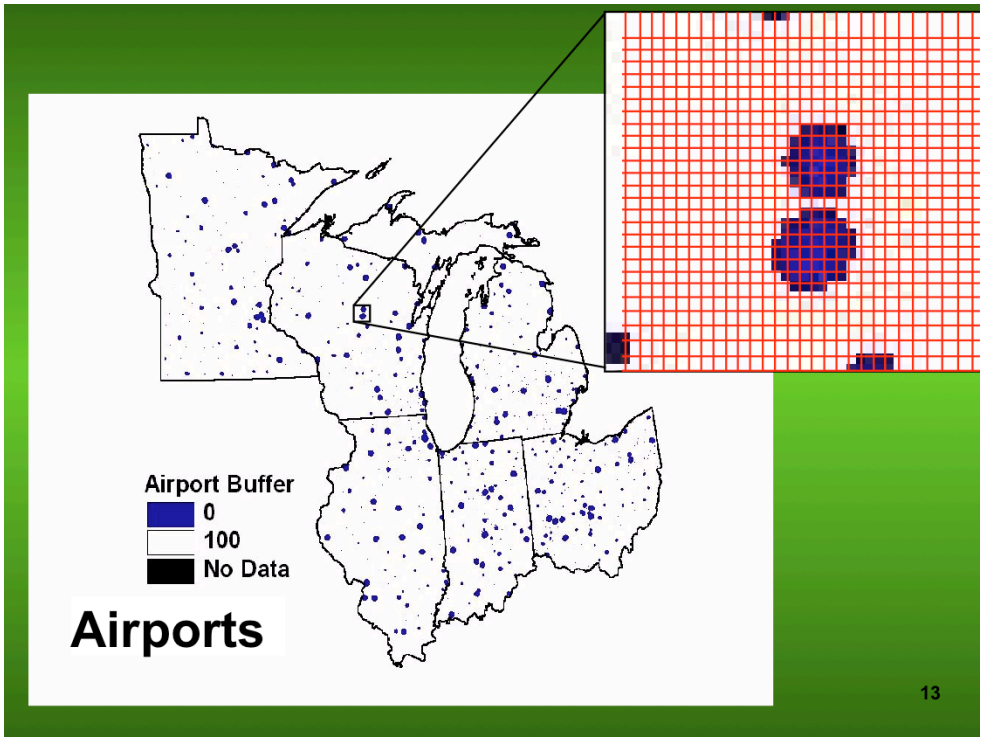
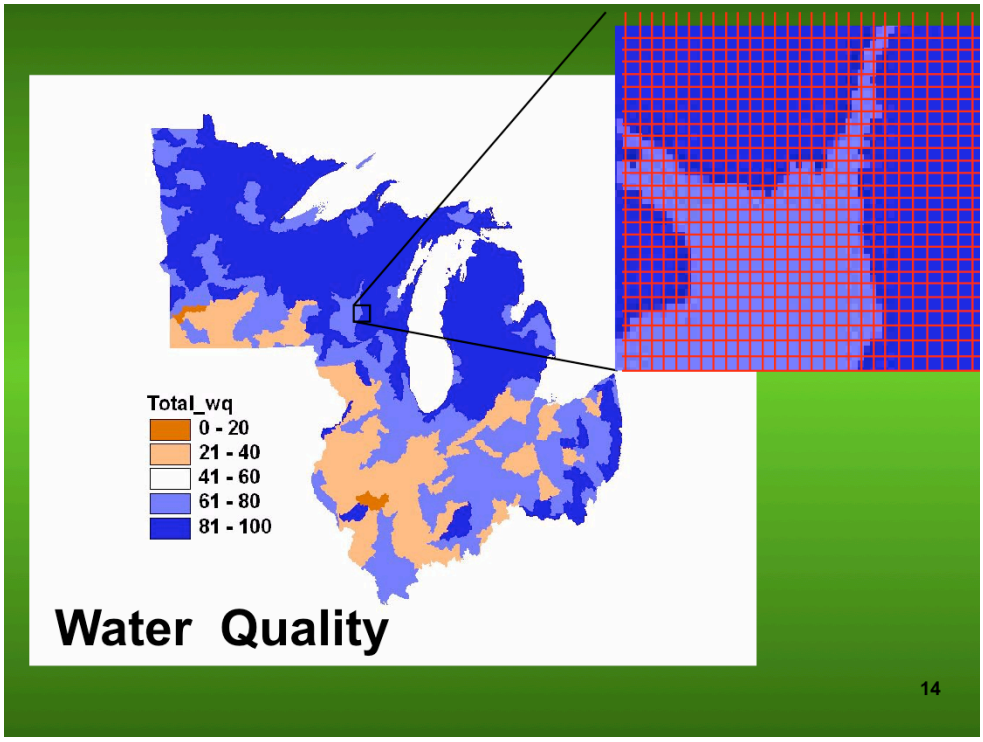
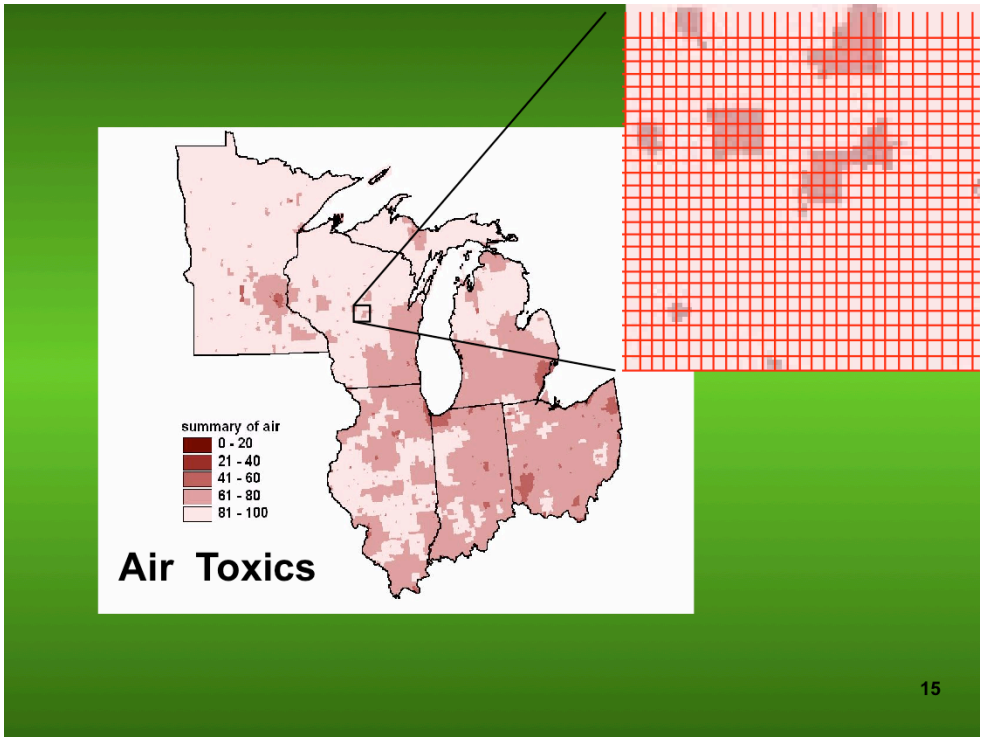
CrEAM / Essential Ecological Attributes Crosswalk

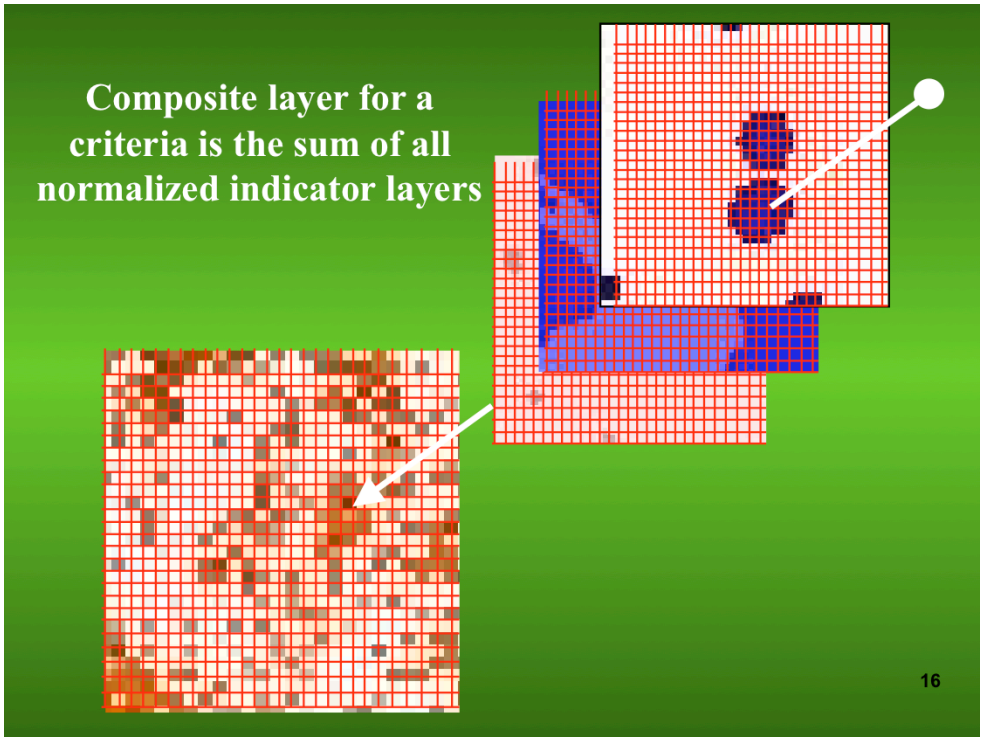
	Diversity	Sustainability	Rarity
Biotic Condition	1	2	3
Landscape Condition	2	5	1
Chem. & Phys. Characteristics		7	
Hydrology & Geomorphology		4	
Natural Disturbance Regimes	1		
Ecological Processes			

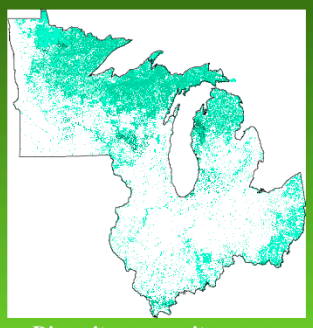
12


Airport Buffer
0
100
No Data
Airports
13

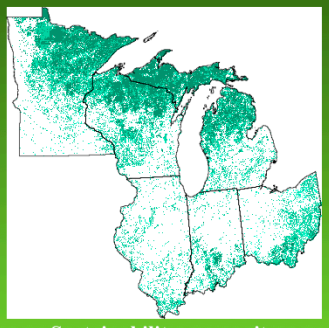

Total_wq
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Water Quality
14


summary of air
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Air Toxics
15

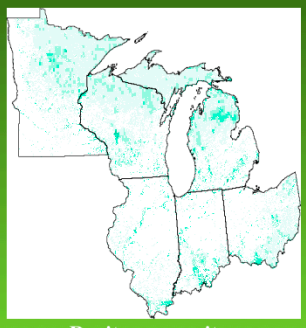

Composite layer for a criteria is the sum of all normalized indicator layers
16



Diversity composite
scores 0 - 397



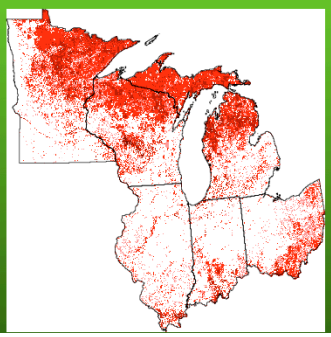
Sustainability composite
scores 464 - 1157



Rarity composite
scores 0 - 331

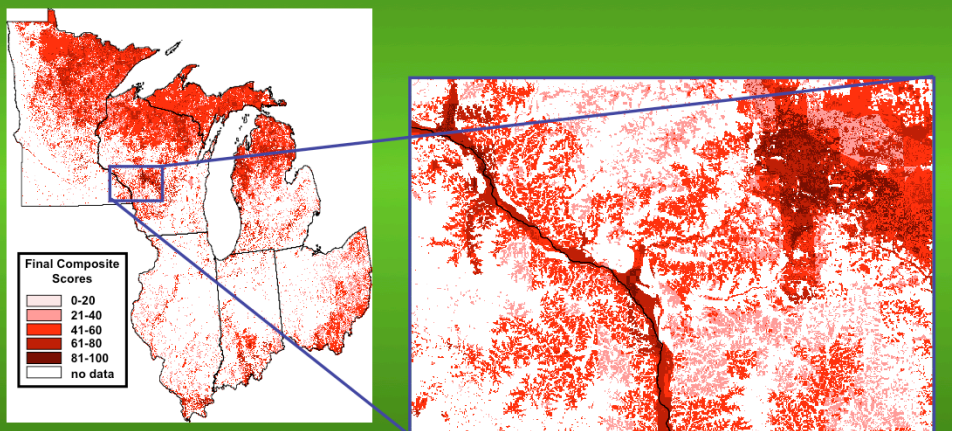
Results

Criteria scores were normalized between 0 – 100 and added for a final ecosystem score.
range = 23-253
mean = 139



17

Final Composite of Ecological Condition

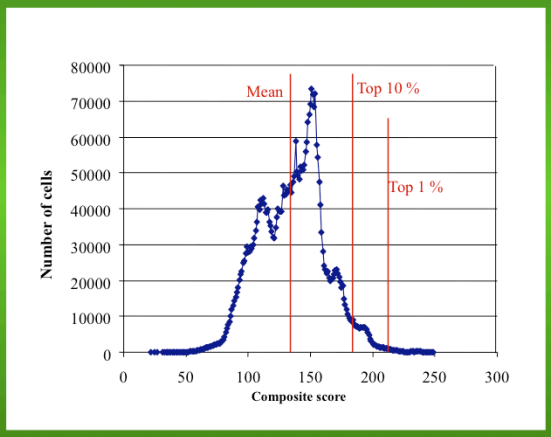


18

Results

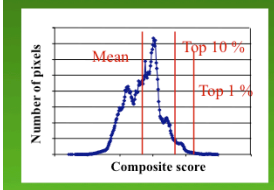
Distribution of composite ecosystem scores

low = 23
high = 253
mean = 139

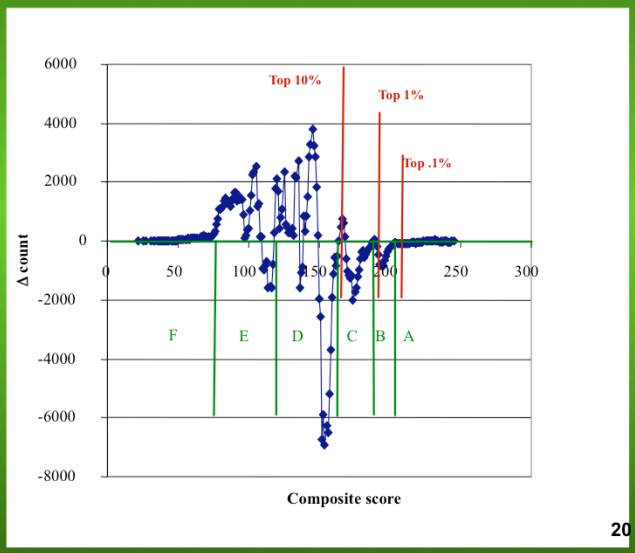


19

Results

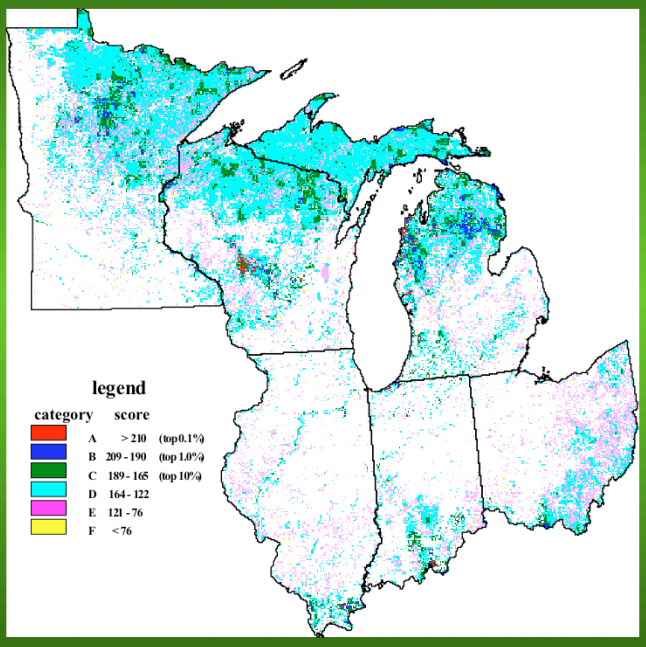


first derivative



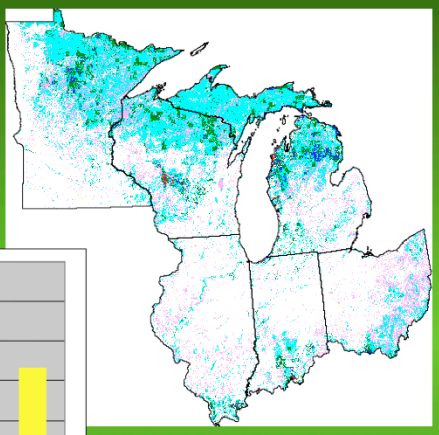
20

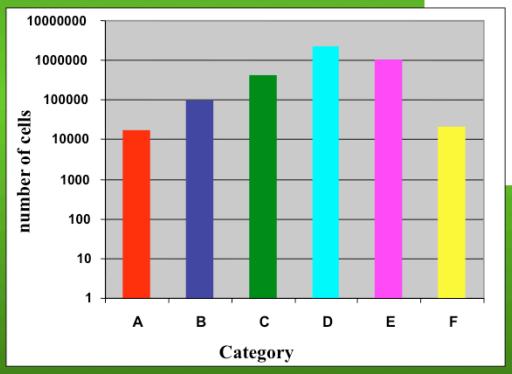
Ecological Significance Ratings



21

Ecological Significance Ratings





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Critical Ecosystem Assessment Model

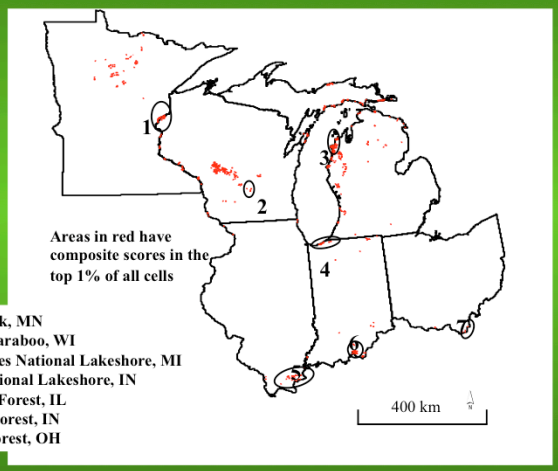
To validate and evaluate model:

1. Best Professional Judgment
2. Statistical Analysis
5. SAB review
6. Field validation (RARE grant)
7. Peer review in journals

23

Validation

1. Best Professional Judgment



Areas in red have composite scores in the top 1% of all cells

1 St. Croix State Park, MN
2 Wisconsin Dells, Baraboo, WI
3 Sleeping Bear Dunes National Lakeshore, MI
4 Indiana Dunes National Lakeshore, IN
5 Shawnee National Forest, IL
6 Hoosier National Forest, IN
7 Wayne National Forest, OH

2. Sensitivity Analysis

Within criterion correlation of data layers:

Diversity

0.41 between land cover diversity and contiguous area of undeveloped land

Sustainability

0.45 between weighted road density and development buffer

Rarity

0.52 between rare species abundance and rare taxa abundance

Thus we conclude that the individual data layers *within* a criterion do not duplicate each other.

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Sensitivity Analysis

Correlations between individual criteria and their relationship with the total composite score. All correlations are significant at p < .0001; N = 3,634,183.

	Total Composite Score	C1 Composite Score	C2 Composite Score	C3 Composite Score
Total Composite Score	1.00	.59	.51	.34
C1 Composite Score	.59	1.00	.40	-0.02
C2 Composite Score	.51	.40	1.00	-0.08
C3 Composite Score	.34	-0.02	-0.08	1.00

Thus we conclude that the criteria do not duplicate each other

26

Evaluation of Model
3. SAB Review June 2004

http://www.epa.gov/sab/panels/epec_crmpesls.html

5. Peer Review journal article

The Critical Ecosystem Assessment Model (CrEAM)
Identifying healthy ecosystems for environmental protection planning
Mary L. White, Charles G. Maurice, Amy Mysz, Thomas Brody
In
Campbell, J.C., K. B. Jones, J. H. Smith and M. T. Koppe
North American Land Cover Summit
Association of American Geographers, 2008

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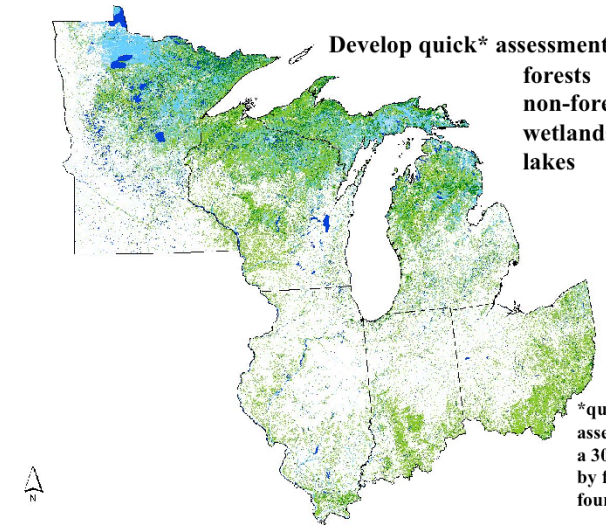
Validation of Model
4. RARE Grant 2003-2005



Develop quick* assessment protocols for
- forests
- non-forest terrestrial
- wetlands
- lakes

*quick means assessment of a 300 x 300 m parcel by four people in four hours.

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Proposed Uses of the CrEAM

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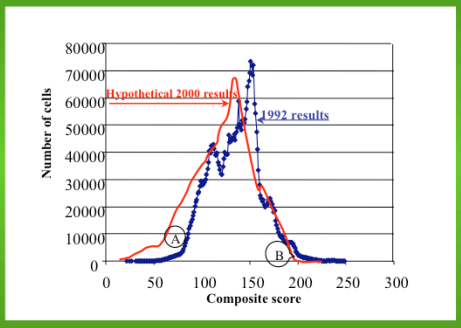
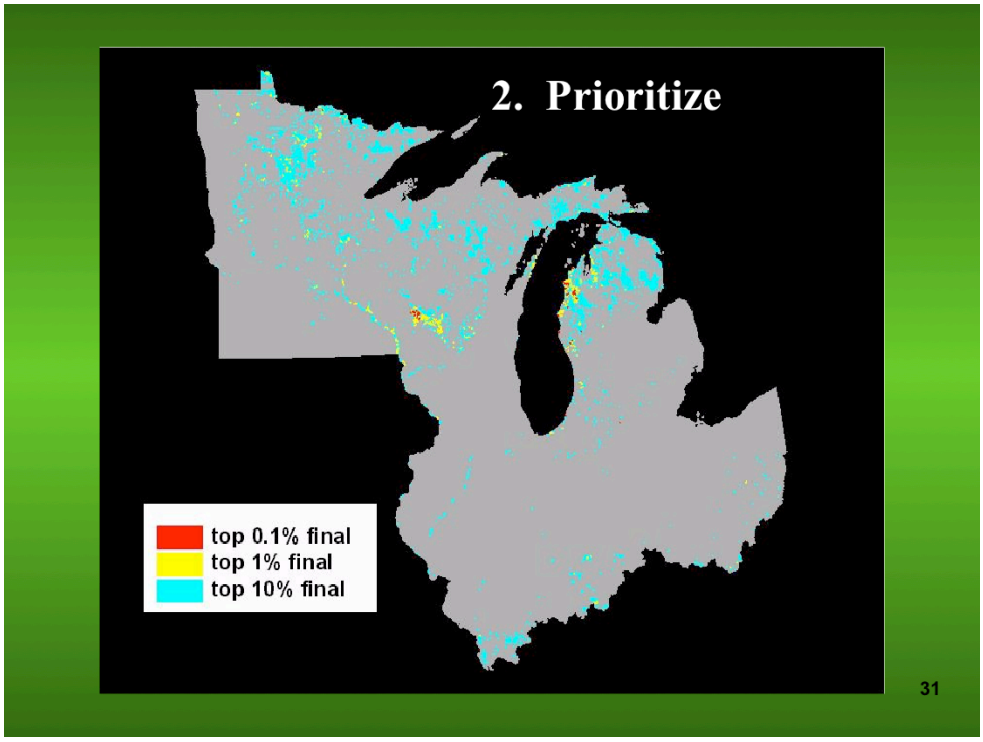
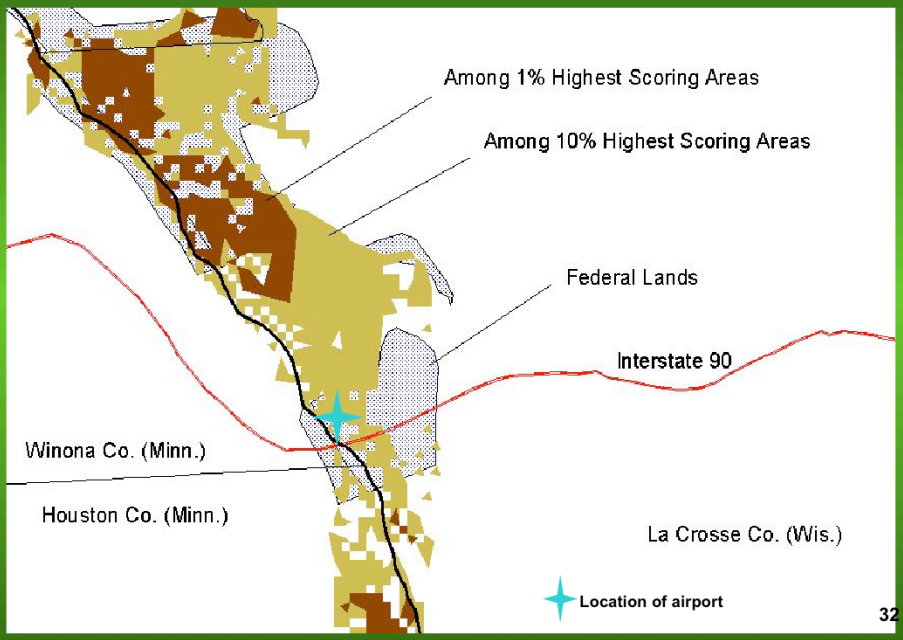
1. Quantify and Track Ecosystem Quality



30

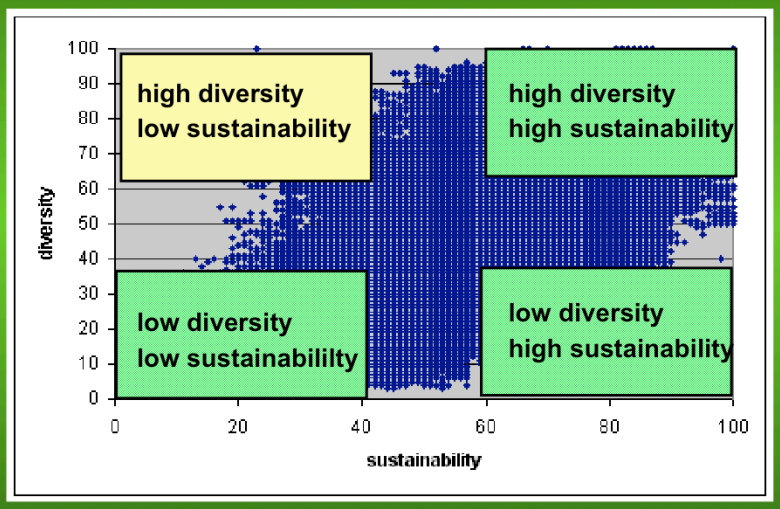

2. Prioritize
top 0.1% final
top 1% final
top 10% final
31

3. NEPA Reviews

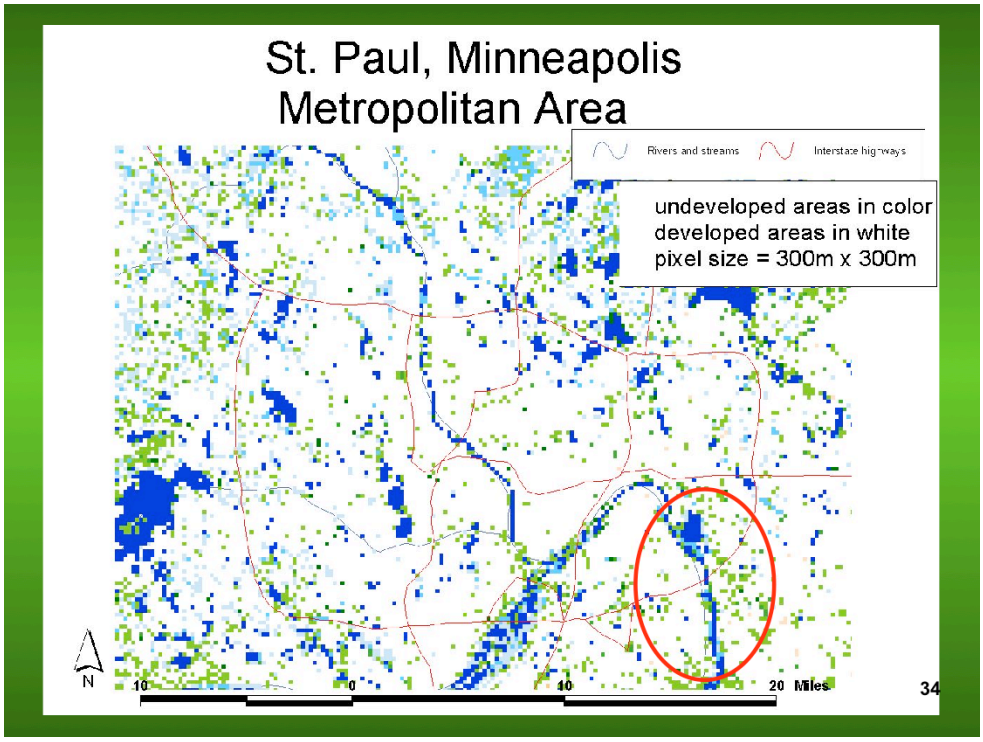


32

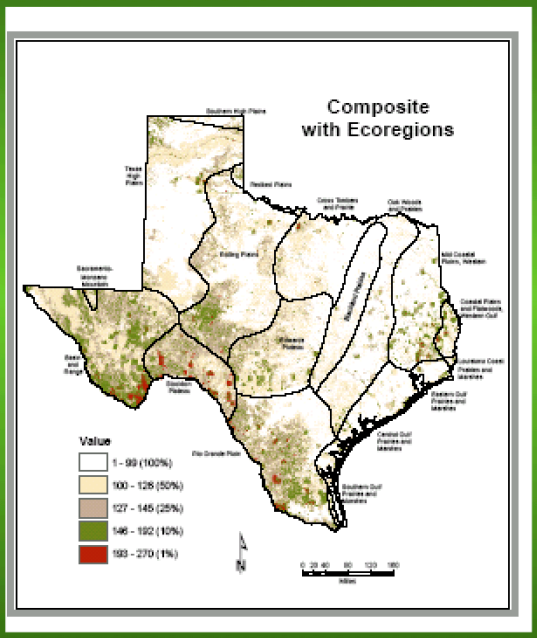
4. Targeting



33


St. Paul, Minneapolis
Metropolitan Area
Rivers and streams
Interstate highways
undeveloped areas in color
developed areas in white
pixel size = 300m x 300m
N
10
0
10
20 Miles
34

Texas Environmental Resource Stewards



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Primary Collaborators

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Critical Ecosystems Team

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Pesticides Program

Robert Beltran & John Schneider
Gt. Lakes Nat. Program Office

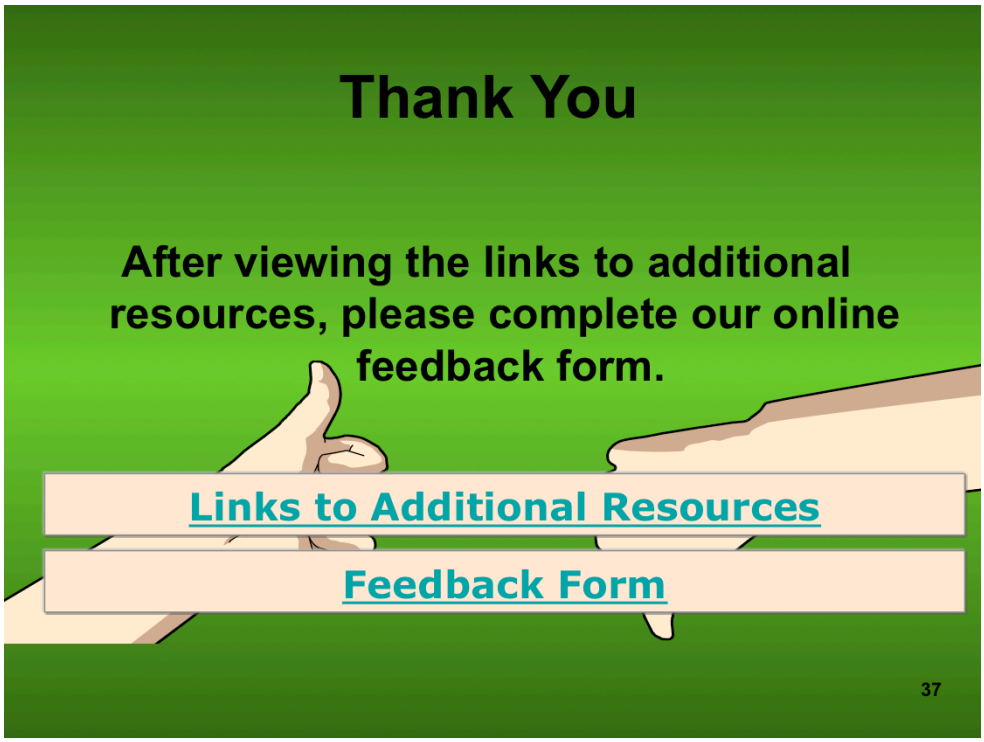
Mike Gentleman
Water Division

Lawrence Lehrman
Office of Information Services

Brenda Jones
Superfund Division

Dan Mazur
Waste Management Program

36


Thank You
After viewing the links to additional resources, please complete our online feedback form.
Links to Additional Resources
Feedback Form
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